

**THE IMPACT OF THE STRONG EURO ON THE REAL  
EFFECTIVE EXCHANGE RATES OF THE TWO FRANCOPHONE  
AFRICAN CFA ZONES**

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## **ABSTRACT**

This paper estimates the degree of misalignment of the CFA franc since the introduction of the euro in 1999. Using a relative purchasing power parity-based methodology, the study develops a monthly panel time series dataset for both the Central African CEMAC zone and the West African UEMOA zone to compute a trade-weighted real effective exchange rate (REER) indexed series from January 1999 to December 2004. The main finding of the paper is that the REER appreciated by close to 8 percent in UEMOA and 7 percent in CEMAC, influenced by the volatility in the euro-dollar bilateral exchange rate and conservative monetary policies in the two zones, resulting in a partial loss of competitiveness in export markets. The lower appreciation in Central Africa can be explained by lower inflation in CEMAC than in UEMOA and by the greater trade with higher inflation East Asian countries, partially offset by the peg to the dollar. However, the inclusion of “unrecorded trade” results in an appreciation of only 6 percent in the UEMOA zone and 6 percent in the CEMAC zone due to higher inflation in the two countries with unmonitored cross-border flows, Ghana and Nigeria. Using time series econometrics, an Engle-Granger two stage procedure for cointegration, and an error correction framework, a single equation modeling of the real exchange rate from 1970 to 2005 as a function of terms of trade, economic openness, aid inflows, and a dummy representing the 1994 devaluation finds little statistical evidence of a long-run equilibrium exchange rate that is a vector of economic fundamentals. The dummy explains most of the real exchange rate behavior in the two zones, while openness in UEMOA has contributed to an appreciation of the REER.

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## I. INTRODUCTION AND BACKGROUND

*Currency moves are a normal part of global trade. Their impact generally is best left for financial geeks and really bored people to ponder. But not now. The dollar's long slide — and widespread expectations that it will slip further — has officials on three continents fearing that their economies are stretched to the breaking point.*

*(Time, December 21, 2004)*

*Perhaps economic historians will look back on today's patchwork global exchange-rate arrangements as a latter-day Tower of Babel. But what other system is there? With freely flowing capital, a fixed exchange rate has the life expectancy of a Hollywood marriage.*

*(Rogoff, 2002)*

*I find it difficult to imagine a world in which it would not be important to estimate exchange rate misalignments.*

*(Williamson, 1999)*

Proper exchange rate alignment is an important characteristic of sound macroeconomic management in all economies of the world. In recent years with the collapse of the Bretton Woods system of fixed exchange rates among industrial countries, exchange rate issues have become salient. There is a growing recognition that exchange rate overvaluation has a long-term pernicious effect on the performance of manufacturing exports in particular and on economic growth in general (Sekkat and Varoudakis, 1998; Easterly and Levine, 2002). In this context, a broad consensus has emerged that the overriding objective of exchange rate policy in developing countries should be to avoid episodes of prolonged and substantial misalignment. (Hinkle and Montiel, 1999). Moreover, in a world of volatile capital and aid flows, the successful management of the exchange rate regime becomes even more difficult as manifested by the plethora of exchange rate regimes and institutional arrangements that proliferate in the developing world.

One of the oldest and most durable fixed exchange rate regimes in the world is the CFA zone, encompassing 14 francophone countries in Western and Central Africa. A relic of French rule, the CFA zone includes seven countries of the West African Economic and Monetary Union (WAEMU) – Senegal, Cote d'Ivoire, Mali, Burkina Faso, Niger, Togo, and Benin, and six countries of the Central African Economic and Monetary Community (CEMAC) – Cameroon, Gabon, Chad, Central African Republic, Republic of Congo, and Equatorial Guinea. One of the interesting features of the CFA zone has been the surprising resilience of the fixed exchange parity, especially in a post-Bretton Woods world where flexible exchange rates have become more the norm than the aberration.

Originally pegged to the French franc since 1948, the CFA franc was pegged to the euro after the introduction of the euro on January 1, 1999. Under the guidelines of the euro introduction, all existing pegs were revised based on the original conversions, so that CFA 100 = FF1 was replaced by CFA 665.957 = EURO 1. This rate defines all official trade flows between the countries of the CFA zone and the euro-zone countries. The rationale of the system has been to maintain macroeconomic stability in West and Central Africa as well as strengthen trade and financial flows between Europe and the two zones by creating an environment with a stable exchange rate.

The common currency and free trade zones have several relevant and interesting institutional features. Firstly, the central bank of each zone maintains an Operations Account with

the French Treasury, where they pool 65 percent of their reserves in an overdraft facility and which helps the central banks to maintain the fixed parity to the euro. Furthermore, the central bank (BEAC or BCEAO) has to maintain a foreign exchange cover of at least 20 percent of its liabilities. Secondly, the two communities abide by a set of fiscal and monetary rules designed to reduce the risk of incurring large fiscal and balance of payments deficits. In this context, credit and advances from the central bank to each government cannot bypass more than 20 percent of its revenue during the previous year. Thirdly, the French Treasury has historically guaranteed convertibility of the CFA franc to the French franc before 1999 and to the euro after 1999, with no monetary obligations for either the Bank of France or the European Central Bank. According to some experts, this feature of the CFA franc relationship constitutes a contingent liability of the French Treasury in case of a rundown of the outstanding balances in the operations accounts of the two regional central banks (Hadjimichael and Galy, 1997).

Since the introduction of the euro in 1999, there has been widespread interest on whether the new currency would be a boon or a bane for Africa (Irving, 1999). Arguments that it would help macroeconomic stability, lead to higher investment and trade flows, and spur regional integration were contrasted with fears that the euro would result in a loss of export markets and slow down local growth. There was particular concern that volatility in the euro-dollar exchange rate would create uncertainty in the CFA zone. Nevertheless, this paper tries to address some of the exchange rate issues by taking stock of events five years after the introduction of the euro.

The remainder of the paper is organized as follows. The next section provides an overview of the PPP approach to measuring misalignment. Section III provides the empirical results and gives quantitative measures of misalignment in UEMOA and CEMAC from 1999 to 2004. Section IV uses cointegration techniques to provide a single equation estimation of the long-run equilibrium exchange rate (LRER). Section V summarizes the paper.

## **II. MEASURING MISALIGNMENT**

### **A. LITERATURE SURVEY**

There exists a rich and significant literature on methodologies to calculate exchange rate misalignment, with particular relevance to the CFA zone, and the implications of alternative approaches, but most of the work was done in the context of the 1994 CFA devaluation (Hinkle and Devarajan, 1993; Kiguel and Ghei, 1993; Devarajan, Lewis, and Robinson, 1993; Baffes, Elbadawi, and O'Connell, Ahlers and Hinkle, 1999). A variety of country studies estimating the long-run equilibrium exchange rate have been done on African countries, especially South Africa, Cote d'Ivoire and Ghana (MacDonald and Ricci, 2003; Bogetic et al, 2004; Opoku Afari, 2004). However, there has been little empirical work on the effects of the introduction and consequent appreciation of the euro on the real effective exchange rates of the CFA zones and the implications of any CFA appreciation. However, one recent study (Ouattara and Strobl, 2004) uses dynamic panel analysis to find that foreign aid inflows do not generate Dutch disease effects in 12 countries of the CFA zone. This work will try to fill the gaps in the recent literature.

### **B. METHODOLOGICAL OVERVIEW AND DATASET**

The measurement of exchange rate misalignment is a complex exercise, sensitive to the analytical framework and methodology used. Given the impossibility of direct observation of the equilibrium exchange rate, a plethora of methodologies have been developed to quantitatively

assess the equilibrium exchange rate and measure the extent of misalignment.<sup>1</sup> In this paper, I measure misalignment in the CFA zone since the euro introduction using a traditional relative PPP methodology with a base year representing the equilibrium real effective exchange rate. I constructed a panel dataset of two separate real effective exchange rate series for both CFA zones (UEMOA and CEMAC) from January, 1999 to December, 2004. Nineteen countries were selected in UEMOA and thirteen were selected in CEMAC based on their trade shares with the zone, and sixty monthly calculations were made for each country to compute the bilateral effective exchange rate.

Using methodology adapted from Hinkle and Nsengiyumva (1999), I calculated a monthly real effective exchange rate index for the two zones in which a trade-weighted nominal effective exchange rate is adjusted for relative inflation in the home country and its trading partners. The multilateral real exchange rate was defined as a geometric product of the bilateral real effective exchange rates. Trade weights using both imports and exports are averaged for two years and are calculated for each regional grouping, while monthly CPI indices are calculated for the two zones and for the trading partners based on a weighted average of individual countries' monthly CPIs. Monthly exchange rates are used in the model to ensure the minor fluctuations in exchange rates are captured in the analysis. A 1999 base year is chosen in which it is assumed that the balance of payments was in equilibrium, and the percentage difference between the actual and equilibrium exchange rate measures the extent of misalignment. This approach also assumes a constant equilibrium exchange rate and stable long-run parameters within the period. While the approach has certain shortcomings, it has a number of practical advantages in estimating the equilibrium RER in low-income developing countries:

The simplest methods of estimating the long-run equilibrium RER are based on relative PPP. Although more sophisticated methodologies that take into account variations in the fundamentals determining the LRER have been developed, the PPP-based approaches are still widely used in both graphical analyses of individual countries and in econometric analyses of large multicountry samples... Its data requirements are limited. The methodology is both straightforward and transparent. With simple computer spreadsheets it is easy to run extensive sensitivity analyses of the results assuming different base years or means. A number of multicountry statistical analyses of misalignment are also available for comparative purposes. These are significant practical advantages for balance-of-payments management in a developing country in which data and professional manpower may both be limited... PPP-based analysis is also widely used for making initial diagnoses of individual countries. (Ahlers and Hinkle, p. 296; 312-313, 1999)

In the second part of the paper, following Edwards (1989) and Baffes, Elbadawi, and O'Connell (1999), I use another more complex but less data-intensive methodology involving time series cointegration techniques, as well as the Engle-Granger two-step procedure and error correction modeling, to try to estimate the long-run equilibrium exchange rate as the function of the terms of trade, economic openness, aid inflows, and pre and post-devaluation scenarios. While it is well-known that currencies depart from their long-run values, the method attempts to find if there is a longer-run equilibrium where the fundamentals converge.

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<sup>1</sup> Four principal methods have been used in the extensive literature: a relative purchasing power parity-based methodology that assumes a stationary long-run equilibrium exchange rate, a target resource balance methodology that employs trade equations and elasticities, a single equation approach that estimates the equilibrium exchange rate as a function of several fundamentals, and simulations based on empirical general equilibrium models. (Williamson, 1994; IMF, 1998; Hinkle and Montiel, 1999)

The dataset comprises a variety of different cross-sectional and time series information. Inflation data (CPI) and import and export figures for both the CFA zone and the trading partners from 1999 to 2004 were obtained from the International Monetary Fund's *International Financial Statistics*. Monthly bilateral exchange rates of the CFA vis a vis its trading partners were obtained from FX history, the largest foreign exchange database on the Internet. The site gives monthly exchange rates of any two currencies in the world as an average of all daily rates from 1997 to 2005. Data on terms of trade, defined as export prices divided by import prices, were obtained from the World Bank's *World Development Indicators*. Trade weights for the two zones were calculated based on aggregating individual country export and import data from the IMF's *Direction of Trade Statistics* and were determined by taking the share of the zone's trade with each trading partner. Information on GDP and other relevant macro variables is from the World Bank's *World Development Indicators*. Data on aid flows were obtained from the World Bank's *Global Development Finance* database.

## C. PPP APPROACH

### 1. BILATERAL AND MULTILATERAL EXCHANGE RATES

The first step of the analysis is the computation of the bilateral exchange rate comparing the price of a representative production or consumption basket in UEMOA and CEMAC with the price of a representative basket in a foreign country measured in the same currency.

$$(1) \text{BRER}_{dc} = E_{dc} * P_{Gf} / P_{Gd}$$

where  $E_{dc}$  is the index of the nominal exchange rate, defined as the units of domestic currency per unit of foreign currency,  $P_{Gf}$  is the foreign price index, and  $P_{Gd}$  is the domestic price index.

The second step of the analysis is to calculate the real effective exchange rate as a geometric weighted average of the bilateral real exchange rates with each of its main trading partners or competitors.

$$(2) \text{REER}_{dc} = \Pi (E_{dci} * P_{Gf} / P_{Gd})^{wid}$$

where  $m$  is the number of trading partners or competitors of the home country and  $\Pi$  denotes the product of the bracketed terms over the  $m$  countries. The geometric averaging method is used where  $wid$  is the appropriate weight for each foreign country  $i$  ( $i = 1, \dots, m$ ) and the sum of the weights must equal one. Following the Hinkle-Nsengiyumva methodology, the external RER indexes can be measured either in domestic currency or foreign currency terms, which are the inverse of one another. Thus, an appreciation corresponds to an increase in the real effective exchange rate index in foreign currency terms but to a decrease in the index in domestic currency terms. The domestic currency measures were used to obtain the foreign currency equivalents.

### 2. CHOICE OF BASE YEAR

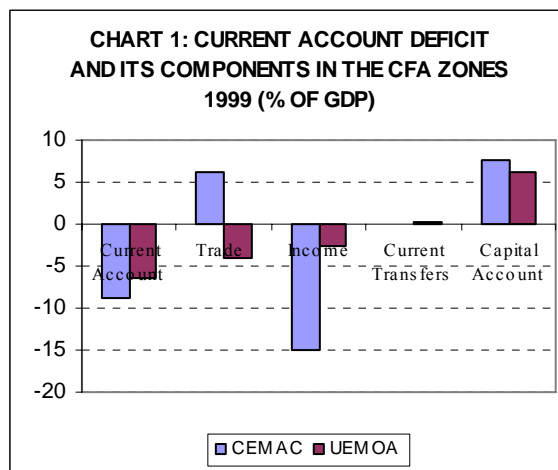
In order to calculate a real effective exchange rate series and assess the degree of misalignment, a base year has to be chosen in which the key objectives of macroeconomic policy are fulfilled- internal balance and external balance. The long-run equilibrium real exchange rate is the rate at which the economy attains both external and internal balance. By definition, internal



balance is a situation in which real output is at or close to its potential or capacity level, and the inflation rate is low and nonaccelerating (full employment and price stability), while external balance is defined as a current account position that can be sustained by capital flows on terms compatible with the growth prospects of the economy without resort to restrictions on trade and payments, so that the level of international reserves is adequate and relatively stable. (Khan, Nsouli, and Wong, 2002) In this formulation, internal balance equals trend output, and external balance is equal to the value of the target capital account. Internal balance occurs when the markets for labor and nontraded goods clear and external balance represents a clearing of the tradable goods market with an increase or decrease in the stock of net foreign assets that is need to balance the capital and the current accounts. By definition, the capital account is equal to the excess of domestic savings over investment. Thus, all the prevailing macroeconomic balance approach models see exchange rate equilibrium as the level that generates an underlying current account equal to the target capital account when the domestic and foreign economies are in internal equilibrium.

However, in practice, the choice of an appropriate base year is an inevitably subjective process, especially when dealing with aggregations of countries with different structural characteristics facing diverse terms of trade shocks. There are years in which some, but not all of the requirements are fulfilled. Furthermore, the interpretation of target current accounts is a judgment call based on views on optimal savings and investment decisions and on proper calculation of price and income elasticities of trade flows. Thus, there is an inherent difficulty in finding a year in which the current account has been at a satisfactory level. After the determination of the base year, the misalignment is judged as the percentage of deviation between the real effective exchange rate in the final year of the analysis and the equilibrium base year.

For the current analysis, the year 1999 was chosen because the average inflation in both the CEMAC and UEMOA zones was close to zero, and the economic growth in almost all countries in the zone (with the conspicuous exception of Gabon) was significantly positive. The current account deficits were not significantly different from other years, and external financial flows allowed countries to finance this imbalance between savings and investment. Chart 1 shows the breakdown of the current account deficit in 1999 in the two zones by category. In the CEMAC zone, the large negative net income (due to a combination of repatriation of oil profits by companies and interest paid on public and private debt) compensated for the positive trade balance to give a current account deficit (including grants) of -8.7 percent of GDP, while in the UEMOA zone, a trade deficit, coupled with a net income deficit resulted in a current account deficit of -6.4 percent of GDP. Overconsumption in both zones has led to persistent current account deficits, but in both zones, a combination of aid flows and capital transfers led to a strong capital account balance to offset the current account position.



### 3. CHOICE OF PRICE INDEX

The analysis uses the CPI (consumer price index), which is the most commonly used price index in macroeconomic work because it is easily available on a monthly basis and because

it is representative of the consumption sector of any economy. However, since it includes both traded and nontraded goods, it is not the ideal index for measuring competitiveness of traded goods. In Western and Central Africa, due to a weak statistical base, it is frequently the only inflation indicator available for economic analysis and hence, was widely used in the exercise. However, for trade with Western Europe and Northern America, while the CPI's were used, a set of simulations was conducted using the WPI (wholesale price index), which is more heavily weighted towards tradeables.

#### **4. CHOICE OF TRADE WEIGHTS**

Country weightings were chosen based on shares of total trade for both regional imports and regional exports averaged over two years (2000 and 2001). In the CEMAC and UEMOA zones, many of the trading partners are similar for exports and imports so it was not necessary to disaggregate the REER's. The sum of the weights was adjusted to equal 1. Furthermore, since the analysis was for only five years, there was no need to provide annual updates of the trade weights. However, a set of simulations were run using trade shares including unrecorded trade obtained from survey data, especially from Nigeria and Ghana, and the weighting schemes were adjusted accordingly. Fortunately, for the sake of the analysis, much of this unrecorded trade did not occur in parallel markets, since both Nigeria and Gabon have reformed their exchange rate regimes, and differentials between parallel and market rates in these countries is minimal. Thus, for the simulations using informal trade, one can safely use measures of official exchange rates. Finally, third-country competition used in several weighting schemes was not used because of data limitations.<sup>2</sup>

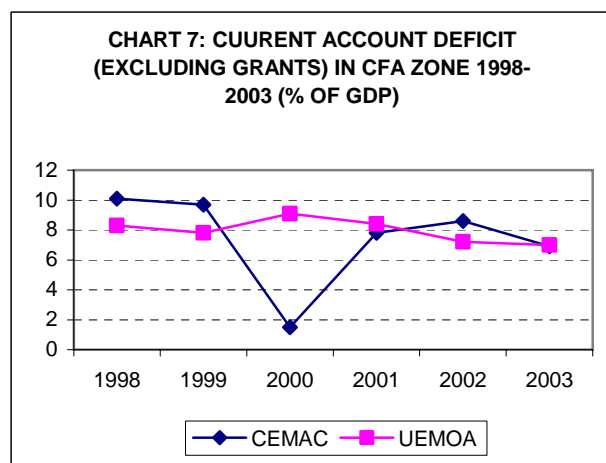
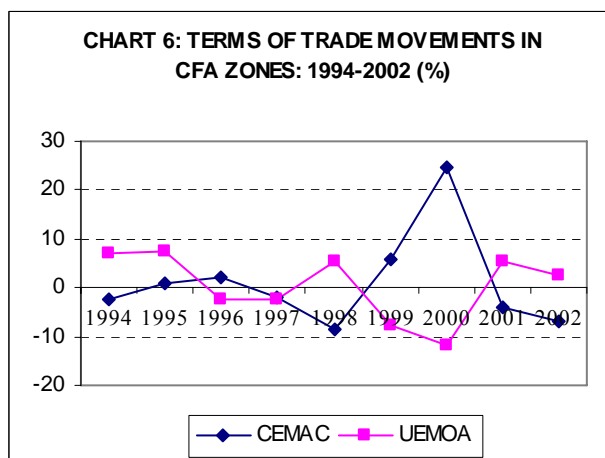
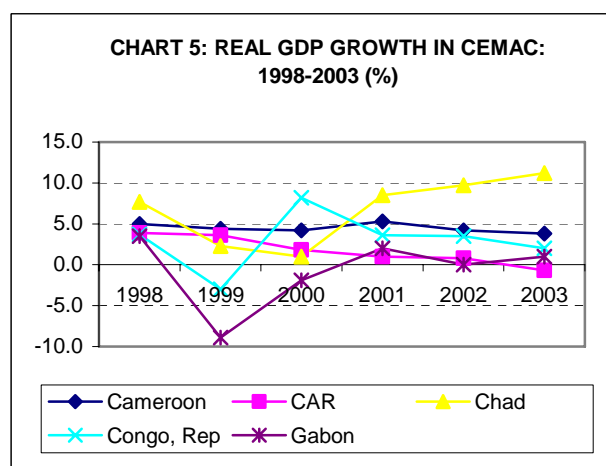
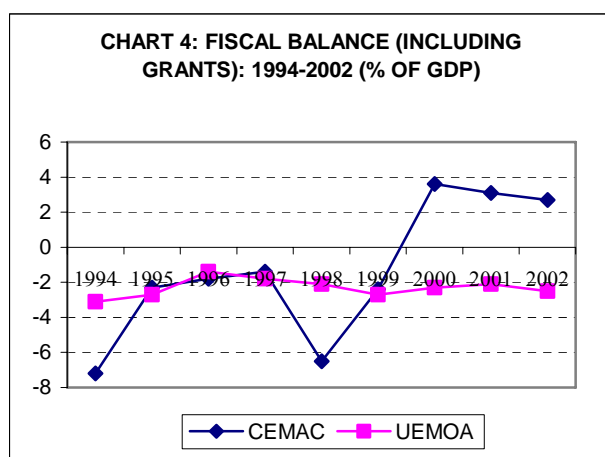
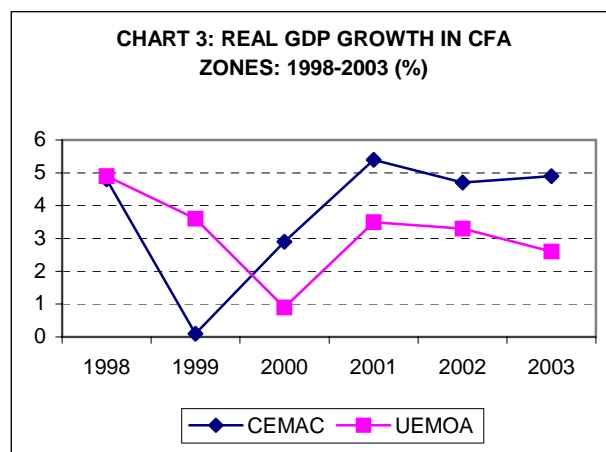
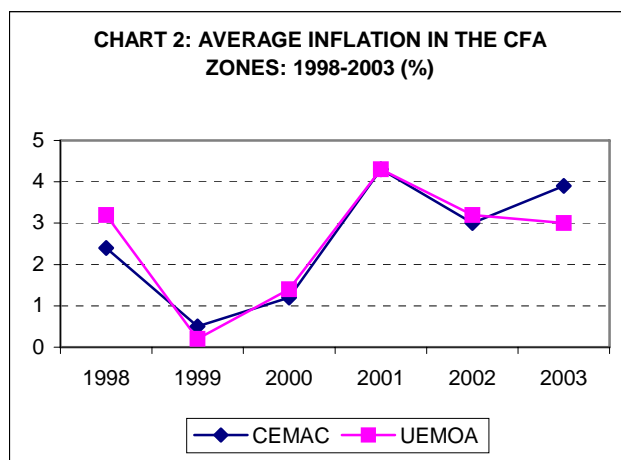
#### **5. CHOICE OF CURRENCIES**

Currencies were chosen from countries which had a share of no less than 0.5% of total UEMOA exports and imports. The currency of the country or area which had the share of no less than 1% among UEMOA or CEMAC total imports and exports on its destination basis in 2000-2001. Under this criterion, more than 10 currencies are included in the study - the euro, the British pound, the US dollar, the Algerian dinar, the Ghanaian cedi, the Chinese yuan, the Korean won, the Indonesian rupiah, the Taiwan dollar, the Nigerian naira, the Canadian dollar, the Japanese yen, the Moroccan dirham, the India rupee, the Thai baht, and the Brazilian real. Monthly nominal bilateral rates were obtained over a span of five years for each of the currencies, and bilateral and effective exchange rate indexes were calculated from these monthly numbers.

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<sup>2</sup> The International Monetary Fund's Information Notice System (INS) is the only official source that uses a model of competition in international markets to obtain trade weights that reflect third country competition. (Zanello and Desruelle, 1997)

## EXTERNAL AND INTERNAL BALANCE IN THE CFA ZONES



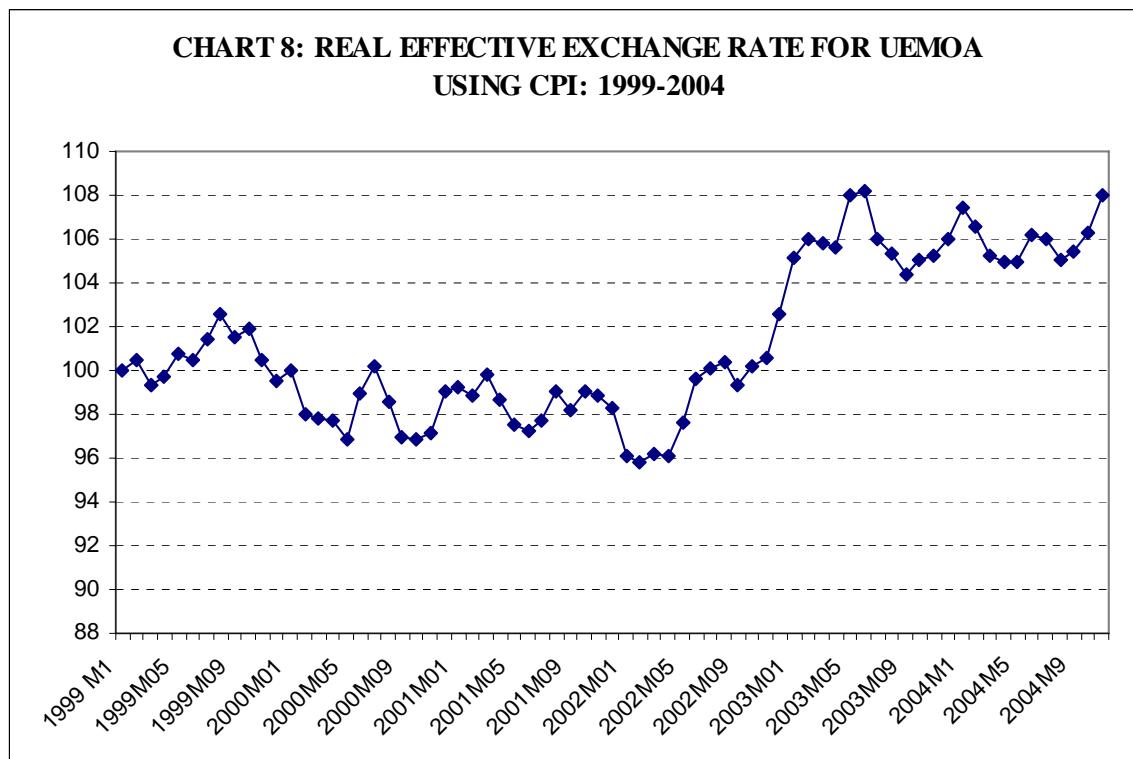
Source: IMF, World Bank databases

### III. REAL EXCHANGE RATE BEHAVIOR IN THE TWO ZONES

#### A. UEMOA ZONE

The evolution of the real effective exchange rate since the 1999 introduction of the euro can be divided into three distinct phases. Firstly, from January, 1999 to April, 2002 there was close to 5 percent improvement in the external competitiveness of the UEMOA zone due to a combination of a protracted slide in the value of the euro against the dollar and other major currencies due to higher projected growth in the US as well as interest differentials between the euro zone and others. By the beginning of 2000, the euro fell below parity with the dollar. Furthermore, lower inflation rates in the UEMOA zone relative to many of the competitor nations helped keep the REER low. In the second phase, from May, 2002 to September, 2003 there was quite a significant appreciation of close to 12 percent due to the gain in the euro against dollar. This was partially prompted by the twin fiscal and current account deficits in the United States, which have required possible corrections through a sustained dollar depreciation, as well as greater market confidence in the euro. Finally, after October, 2003, the REER has revolved around a stable mean. The chart below documents the trends, with an increase in the REER indicating an appreciation and a decrease indicating depreciation. Over the entire period, the REER appreciated by slightly over 8 percent.

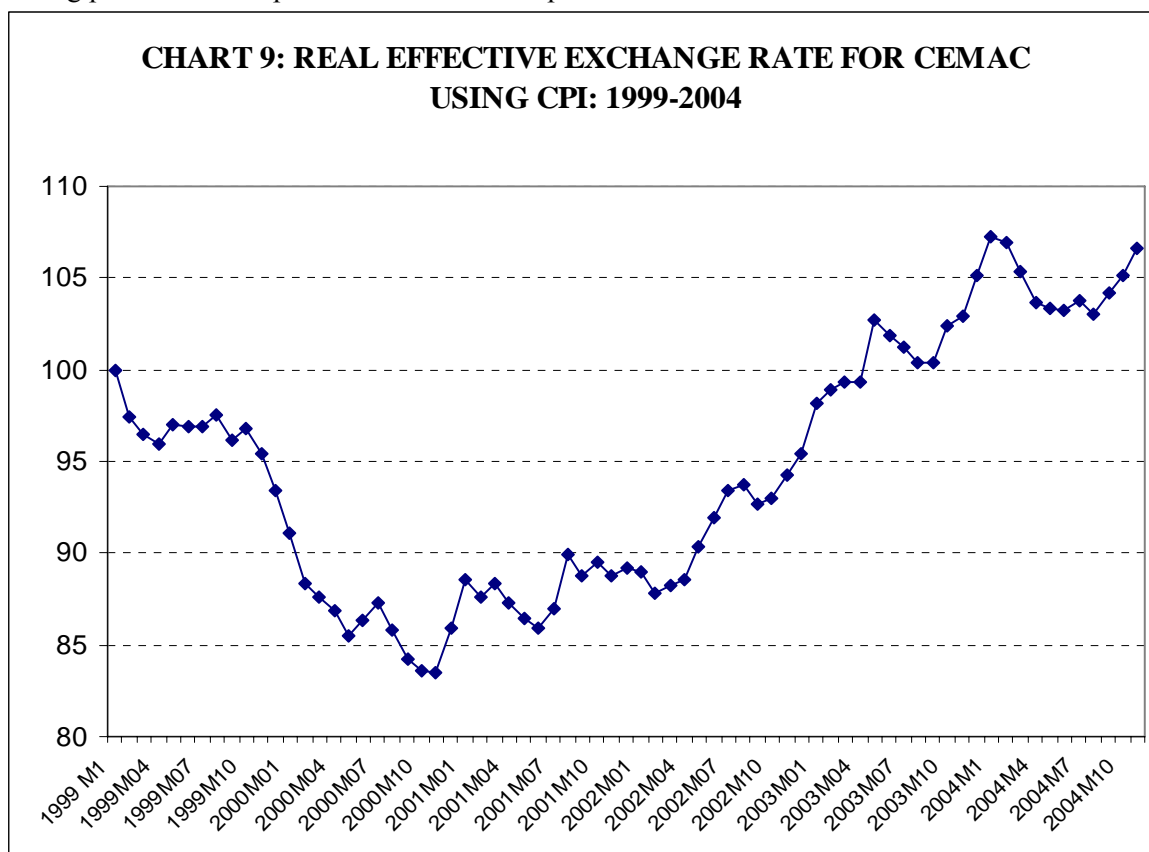
An analysis of the movements of the bilateral exchange rates provides evidence of composition of changes in the REER. The volatility in the euro-dollar exchange rate has been the primary influence on the REER since close to 30% of the zone's trade occurs with the United States, other countries pegged to the dollar like China and the Republic of Korea, or to African countries like Nigeria and Ghana, whose exchange rate fluctuations closely parallel the dollar. Since close to one-third of the zone's trade was with the euro zone in 2000-2001 and the inflation differentials between the zone and Europe were insignificant due to prudent monetary policy in both places, there was not much volatility in the bilateral real exchange rates with the European countries.



## B. REAL EXCHANGE RATE BEHAVIOR IN THE CEMAC ZONE

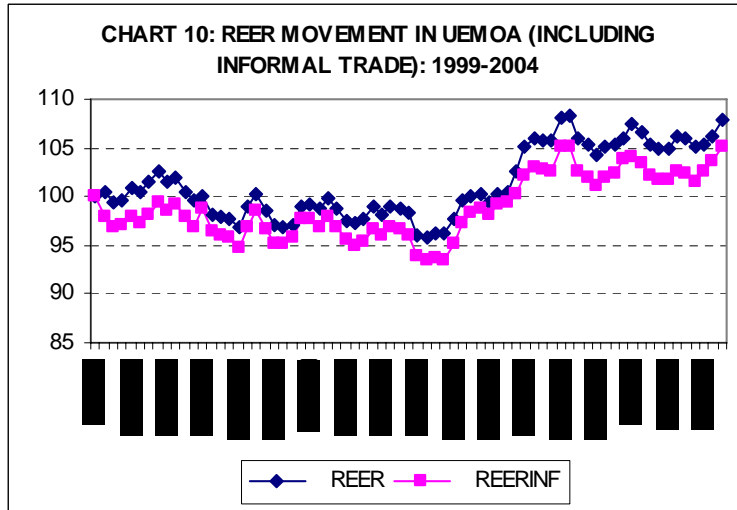
The behavior of the real effective exchange rate for the CEMAC zone follows a similar path to the UEMOA zone, appreciating 7 percent from 1999 to 2004. The evolution of the real effective exchange rate since the introduction of the euro can be divided into two phases. Firstly, from January, 1999 to January, 2001 there was a decrease in the REER index by more than 15 percent as the euro slid against the dollar as well as vis a vis other currencies linked to the dollar. During the second phase, from January, 2001 to December, 2004 there was an appreciation of 25 percent due to the gain in the euro against the dollar and other currencies. As in West Africa, the main reason for this was the twin deficits in the US, which have resulted in a sustained dollar depreciation and greater market confidence in the euro. Also, prudent monetary management at the BEAC resulting in lower inflation than that of many trading partners, reduced misalignment. In particular, low inflation in Chad of -4.6 percent in 2004 dampened the appreciation.

One of the main reasons for the lower appreciation of the CFA in Central Africa as opposed to West Africa, has been the very low inflation in the CEMAC zone of less than 1 percent in 2004 compared to more than 3.5 percent in UEMOA. Furthermore, higher inflation in Central Africa's trading partners such as East Asian economies, especially in China (9.4 percent in 2004), also reduced the extent of appreciation. While West Africa historically trades with Europe, Cameroon, Gabon, and the Republic of Congo are fast becoming important sources of resources of energy and mineral wealth for burgeoning resource-starved Asian economies like China and Taiwan (China). After the United States, with 21.1 % of trade share in 2000-2001 and France with 18.8 percent, amongst Central Africa's largest trading partners are Taiwan (China) with 7.6 percent, China with 6.4 percent and Korea with 4 percent. Thus, greater inflation in its trading partners has helped CEMAC zone competitiveness.

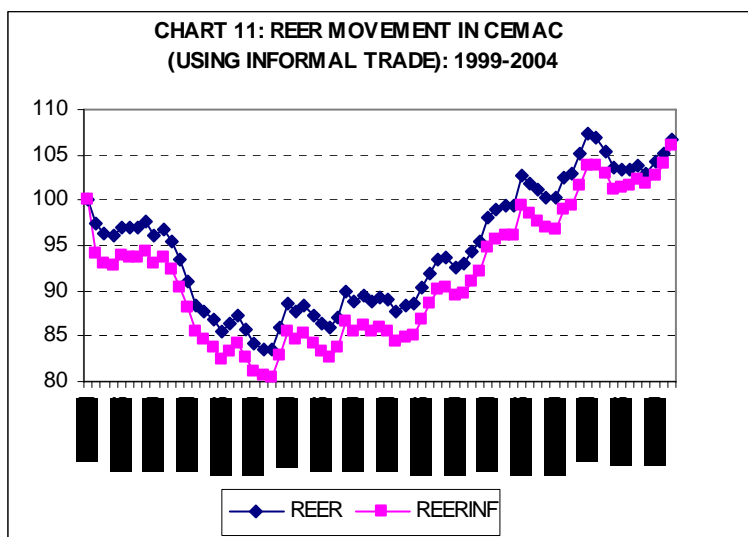


## C. SIMULATIONS

A series of simulations were conducted in order to assess the sensitivity of the calculated real effective exchange rate to changes in price indices of some trading partners and changes in trade weights including more informal trade. The objective was to get precise empirical measures of the elasticity of the REER in both zones to both price and trade shares. Since the wholesale price indicator (WPI) is considered a more comprehensive measure of inflation in an economy than the CPI, the WPI's were included for the trading partners for which there is a consistent and accurate long-run series. The results of the experiment suggested that a change in price index has no major effect on the REER. Because of the global deflation due to overcapacity, the use of alternative price indices does not have any significant effect on the REER.



In a second set of simulations, the trade weights assigned to the trading partners were adjusted to account for informal trade between many of Francophone countries and Nigeria and Ghana. Unfortunately, such trade escapes both the customs regime and official cross-border statistics. Accordingly, for the REER in the UEMOA zone, the trade weights of Ghana were increased from 4.5 to 5.0 percent and the weights of Nigeria increased from 7.3 to 11 percent, and all other weights of trading partners were adjusted accordingly so the combined total of country weights still equaled 1 percent. In the CEMAC zone, the weights for Nigeria were increased from 7.3 percent to 9 percent to account for the large volume of unrecorded Cameroon-Nigeria cross-border trade of livestock, machinery, and oil. The effects of these revisions was to reduce the REER misalignment in UEMOA from 8 percent to 6 percent and the CEMAC misalignment from 7 percent to 6 percent. The decrease in REER after the inclusion of informal trade is due to higher inflation in Nigeria (13.8 percent in 2004) and Ghana (13.0 percent in 2004) vis a vis the CEMAC and UEMOA countries.



## IV. SINGLE-EQUATION ANALYSIS OF THE REAL EFFECTIVE EXCHANGE RATE

### A. THEORY

The final part of the study develops a single-equation empirical model in order to understand the factors which influence the fluctuation in the real effective exchange rate in each of the two CEMAC zones. Essentially, the equilibrium exchange rate is an unobservable variable. However, following in the tradition of Edwards (1989) and Elbadawi (1994), it may be possible to determine the real economic fundamentals affecting the long-run real exchange rate. These models capture the most salient features of macroeconomics in many developing countries. The macroeconomic variables used in the analysis are terms of trade, openness of the economy, and net aid inflows.

- **Terms of trade**, the ratio between the price of exports and the price of imports, can affect the real exchange rate through a variety of channels. While there are observed empirical regularities between the terms of trade and the real exchange rate, the exact effects are ambiguous. Generally, the spending effects of a terms of trade boom result in an appreciation of the real exchange rate, but if the substitution effects dominate, the real exchange rate could depreciate.

- **Openness**, the ratio of imports plus exports over total GDP, is theoretically supposed to result in a depreciation of the real exchange rate through the impact of trade-liberalizing reforms on economic performance. (Baffes, Elbadawi, and Connell, 1999).

- **Aid**, measured as net official transfers as a percentage of GDP for the zone, can result in an appreciation of the real exchange rate if the aid money is used to finance imports or expenditures on non-traded goods, but can cause depreciation if it is used to generate capacity expansion, additional employment, and production in the non-tradeable sectors. The effect of aid in generating possible “Dutch disease” will depend critically on the structure of the economy and the efficacy of aid utilization.

- A **dummy** variable was introduced in order to take into account the devaluation of the CFA franc in 1994. Due to a structural break in 1994, the dummy was introduced to partial out this discontinuity in the time series.

Lack of an accurate, detailed, and internally consistent time series for most of the countries in UEMOA and CEMAC made it difficult to construct indices on government consumption and investment, productivity differentials between countries,<sup>3</sup> net foreign assets, and the relative prices of tradable and nontradables (another definition of the real exchange rate).

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<sup>3</sup> One of the most important explanations of the country differentials in real exchange rates is the Balassa-Samuelson hypothesis, often advanced as an important factor underlying the secular appreciation of industrial countries' exchange rates relative to developing countries. It argues that differentials in productivity between the traded and non-traded sectors in the economy of a country relative to the trading partners has an impact on domestic prices and results in an appreciation of the real effective exchange rate. The theory rests on the critical assumption that it is the tradable sector which determines a country's wage and the non-tradable sector follows. (Balassa, 1964).

## B. ECONOMETRIC METHODOLOGY

The model discussed above is estimated using the following general framework in which the real effective exchange rate in the CEMAC and UEMOA zones is viewed as a function of a vector of fundamentals- terms of trade, openness of the economy, net aid inflows, and government consumption. The dependent variable of the analysis is the log of the real effective exchange rate, essentially a trade-weighted index derived from 1970 to 2005. All variables were put in logarithmic form to ensure that parameters represented elasticities, and annual time series data were used to estimate the following model:

$$(3) \text{ RER} = f(\text{TOT}, \text{OPEN}, \text{AID}, \text{DUMMY})$$

The two principal techniques for the time series estimation of the long-run relationship and cointegration of two variables are the Engel-Granger (1987) and the Johansen methodology (1988), the key diagnostic tools to test for systemic patterns in time series. The essence of cointegration is that even if certain time series themselves are nonstationary, a linear combination of them will be stationary, and that there is a long-run co-movement between the variables. The Engel-Granger technique is a two-stage method that examines cointegration and is based on the assumption that a single cointegration relationship exists, which can be estimated through ordinary least squares.

First, standard unit root tests were performed on all the macroeconomic variables prior to the estimation to ensure that the two variables are integrated of the same order because traditional estimation and inference procedures based on traditional t and F tests do not apply in the presence of nonstationary variables. The optimal lag lengths were determined using the Akaike Criterion. The Augmented Dickey-Fuller test was used to examine whether one can reject the null of a unit root at traditional significance levels. Econometric tests were conducted in order to assess whether the variables were first-difference stationary.

Secondly, the following the Engle-Granger methodology, the long-run equilibrium equation was tested using ordinary least squares (OLS) relating the levels of the real effective exchange rate to the economic fundamentals that affect it (Seddighi, Lawler, and Katos, 2000).

The general “cointegrating regression” is:

$$(4) Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$$

Two models were specified, one excluding the dummy variable and one including the dummy:

$$(5) \log \text{ RER}_t = \beta_0 + \beta_1 \log \text{ TOT}_t + \beta_2 \log \text{ OPEN}_t + \beta_3 \log \text{ AID}_t + \beta_4 \text{ DUMMY}_t + \text{RESIDUAL}_t$$

Thirdly, the residuals,  $\varepsilon_t$ , of the estimated OLS long-run relationships were saved from the previous equation as an estimate of the equilibrium error,  $\varepsilon_t$  and subsequently, tested for stationarity using the Augmented Dickey-Fuller test. It is important to establish the stationarity condition for residuals, which would be an indication of the existence of long-run relationships between these variables. In the absence of cointegrating relationships, OLS estimations produce spurious regressions, but if cointegration does exist, then a simple OLS regression can provide consistent estimates of long-run parameters.



The following equation was tested:

$$(6) \Delta \varepsilon_t = \alpha \varepsilon_t + \alpha_j \Delta \varepsilon_{t-1+j} + \nu_t$$

Finally, the residuals from the previous OLS regression are incorporated into an error correction model which connects the behavior of the short-run and the long-run. In this short-run dynamic model, the error correction variable indicates the proportion of disequilibrium that is adjusted from one year to the next.

$$(7) \Delta Y_t = \text{lagged}(\Delta Y_t, \Delta X_{1t}, \Delta X_{2t}, \dots, \Delta X_{kt}) + \lambda \varepsilon_{t-1} + \nu_t$$

### C. ECONOMETRIC RESULTS

The unit root tests for the variables indicated that all the key series – log of real exchange rate, log of terms of trade, log of openness, and log of aid - were found to be nonstationary in levels since one could not reject the hypothesis of the presence of a unit root. The Augmented Dickey- Fuller tests below show that the ADF statistic in levels was below the 5% critical value and in most cases, below the 10% critical value. The two columns of test statistics in the table below show that for both UEMOA and CEMAC, all the time series yielded values below the critical ones needed. Akaike Criterion, coupled with other diagnostic tests, confirmed that the optimal lag lengths were zero for both series. However, when the ADF statistic was calculated for first differences, the results changed dramatically, and the test statistics were all amply above their critical values. Thus, the series were found to be first difference stationary and sharing a similar stochastic trend. Consequently, the series were found to be integrated in the order of I (1). Visual inspection of residuals and the examination of the error terms confirmed these findings. As a result, due to the same orders of integration of all the variables, the cointegration techniques can be applied to the data.

<b>TABLE 1: AUGMENTED DICKEY-FULLER TESTS FOR UNIT ROOTS</b>				
<b>Number of obs = 34</b>				
	<b>UEMOA Test Statistics</b>		<b>CEMAC Test Statistics</b>	
	Levels	Differences	Levels	Differences
Log exchange rate	-0.756	-6.17	-1.27	-5.79
Log terms of trade	-2.79	-5.45	-1.88	-5.99
Log openness	-2.44	-5.61	-2.21	-5.53
Log aid	-2.76	-6.63	-2.50	-5.66
1% critical value = -3.689 5% critical value = -2.975 10% critical value = -2.61				

The cointegrating regression was then performed using ordinary least squares, and two equations were obtained without the dummy (**Model 1**) and two were obtained with the dummy (**Model 2**). The fit varied with lower R-2 of 0.56 for CEMAC without the dummy variable and 0.34 for UEMOA. It was found that the real effective exchange rate appreciation is positive related to the terms of trade and aid inflows, while negatively related to trade liberalization, a finding which matched the theory. All coefficients were significant. For UEMOA, it was found that terms of trade shocks lead to an appreciation of the real effective exchange rate, with a significant t-statistic. While the coefficient for aid was also positive, and the coefficient for openness negative, these variables were found not to pass significance tests.

However, including the dummy led to a very high R-2 and adjusted R-2 of 0.98 and 0.91 for UEMOA and CEMAC respectively, but it produced insignificance in almost all the other variables. The key variable influencing the movement of the real effective exchange rate in the two zones was the dummy variable which measured pre and post-devaluation outcomes. With the exception of the dummy variable, the coefficient signs did not match the theoretical priors, and moreover, were found to be insignificant, with one key exception. Attached are the four equations from the two models:

#### MODEL 1

$$(8) \text{ UEMOA : } \log \text{ RER}_t = -.32 + 1.206 \log \text{ TOT}_t - 0.410 \log \text{ OPEN}_t + 0.248 \log \text{ AID}_t + \varepsilon_t$$

$$(9) \text{ CEMAC : } \log \text{ RER}_t = 5.5 + .326 \log \text{ TOT}_t - 0.614 \log \text{ OPEN}_t + 0.065 \log \text{ AID}_t + \varepsilon_t$$

#### MODEL 2

$$(10) \text{ UEMOA : } \log \text{ RER}_t = 4.0 - .106 \log \text{ TOT}_t + 0.313 \log \text{ OPEN}_t - 0.045 \log \text{ AID}_t - 0.69 \text{ DUMMY}_t + \varepsilon_t$$

$$(11) \text{ CEMAC : } \log \text{ RER}_t = 5.0 - .110 \log \text{ TOT}_t - 0.010 \log \text{ OPEN}_t - 0.006 \log \text{ AID}_t - 0.40 \text{ DUMMY}_t + \varepsilon_t$$

**TABLE 2: REGRESSION RESULTS ON THE DETERMINANTS OF THE REAL EFFECTIVE EXCHANGE RATE IN UEMOA AND CEMAC ZONES:1970-2005**

DEPENDENT VARIABLES		INDEPENDENT VARIABLES							
Log of real effective exchange rate		Log of terms of trade movements		Log of openness		Log of aid flows		Dummy (0= pre and 1 = post devaluation)	
UEMOA MODEL 1 2									
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	
	1.21	3.82	-.41	-1.05	.25	1.55			
	-.106	-1.49	.313	4.26	-.045	-1.5	-.69	-30.54	
	MODEL 1 R2 = .34 ADJ R-SQUARED= .27; MODEL 2 R2 = .979 ADJ R-SQUARED = .976 # of observations = 35								
CEMAC MODEL 1 2									
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	
	.32	3.36	-.61	-3.50	.06	3.23			
	-.110	-1.79	-.010	-.10	.006	.58	-.40	10.52	
	MODEL 1 R2 = .57 ADJ R-SQUARED= .52 MODEL 2 R2 = .907 ADJ R-SQUARED = .895 # of observations = 35								

Econometric theory and practice suggest that Model B is the better model for several reasons. Firstly, the presence of structural breaks in data generating processes must be allowed for in the specification or else one can have problems with the reliability of the estimators and the distortions in diagnostic tests. Secondly, the magnitude of the 1994 CFA devaluation of 50% suggests that it is a fundamental explanatory variable to explain shifts in the real effective exchange rate. Finally, the R-squared in Model 2 is significantly better than the R-squared in Model 1. As a result, the key findings from Model 2 are the following:

- The movement of the real effective exchange rate in UEMOA and CEMAC cannot be fully explained by a vector of fundamentals.
- The 1994 devaluation is the key factor which explains the movement in the REER in both zones from 1970 to 2004.
- An increase in openness as a result of trade liberalization in the UEMOA zone has resulted in an appreciation of the REER. A 3% gain in economic openness results in a 1% increase in the REER in UEMOA, while in CEMAC there is no relationship.
- There is no evidence that terms of trade are cointegrated with the real exchange rate. This can be partly explained by the fact that the aggregate regional data used in the analysis may obscure the differing terms of trade shocks that affect different countries.
- No evidence was found of Dutch disease as a result of increased aid inflows, negating the theory that suggests that large aid flows cause real exchange rate appreciation.

In the second stage of the Engle-Granger test, the error terms from the two cointegrated regressions were tested for unit roots, and they were found to exhibit stationarity using both ADF and other criterion. The ADF statistics for UEMOA and CEAMC were -5.39 and -5.22 above the critical values of -4.32 established by McKinnon (1991) for 5% level of significance. It is important to note that the tendency of OLS to produce stationary residuals means that the usual Dickey-Fuller test statistics were not appropriate or rigorous enough. The implication of this finding is that there is evidence of cointegrated relationship between the variables.

**TABLE 3: ERROR CORRECTION MODEL RESULTS USING OLS AND LAGGED DEPENDENT VARIABLES**

	UEMOA		CEMAC	
	Coefficients	T-Statistics	Coefficients	T-Statistics
Log of real exchange rate lagged	-.13	-0.27	.58	1.26
Log of terms of trade lagged	.28	1.63	.19	1.33
Log of openness lagged	.33	1.50	.13	.66
Log of aid lagged	.001	.03	.02	.93
Dummy lagged	-.03	-.09	.34	1.73
Residual lagged	-.07	-.33	-.22	-.87
Constant	-2.05	-.97	-4.18	-1.69

Using an error correction framework, the short-run dynamic adjustment toward equilibrium value was tested. The log of the real exchange rate was regressed against the log of the lagged real exchange rate, the log of the lagged openness, the log of lagged aid, and the log of lagged error term. The short-run effects were found to be insignificant across various specifications, with none of the lagged variables having an effect on the differences between the annual real effective exchange rates.

## V. IMPLICATIONS AND FUTURE

The overall finding of the study is that the real effective exchange rate has appreciated by 7 percent in the CEMAC zone and by 8 percent in the UEMOA zone from 1999 to 2004 due to several factors. While there was a great debate in 1999 on the possible impact of the euro on the CFA zone, the study shows that while the magnitude of the appreciation has not been great, it confirms some of the concerns both among policymakers and academics that a strong euro would result in an appreciated REER in the two CFA zones. This has had the effect of making many of the CFA exports more expensive in third country markets and may be one factor helping to explain low and declining market shares for products from the two zones. However, prudent and conservative monetary policy at the BEAC and BCEAO, resulting in lower inflation than in many of the trading partners (who also have more independent monetary policies), has reduced the extent of appreciation.

There are three potential factors that could contribute to a longer-term appreciation of the real effective exchange rate in the CFA zones. Firstly, the appreciation of the euro vis a vis the dollar could continue due to global adjustments of the dollar and other currencies in response to the growing US current account deficit (currently at \$650 billion and close to 6.5 percent of US GDP). In other words, a dollar correction will be needed in order to reduce the current account imbalances in the US. Also, the European Central Bank's historic commitment to price stability ensures that monetary policy in the euro zone will not be used to depreciate the euro. Since the CFA regimes maintain the fixed peg to the euro, its fate is inextricably intertwined with the euro-dollar dynamic.

Secondly, the growing share of trade with East Asia, especially in the CEMAC zone, may continue to cause appreciation of the REER in the two zones, in the absence of large revaluations of East Asian currencies. Since China, Korea, and other East Asian countries operate either fixed regimes pegged to the dollar or managed float regimes in which the central banks intervene heavily through interest rate policy or reserve accumulation so that their currencies do not appreciate vis a vis the dollar, the increased trade will result in an increase in the bilateral effective exchange rates of the two zones vis a vis each of the individual Asian countries. Furthermore, most other developing countries, including several trading partners of CEMAC and UEMOA, manage their exchange rates to maintain export competitiveness and prevent undue gains against the dollar. As a result, over the last years, they have developed very strong current-account surpluses. Thus, the less West and Central African Francophone countries trade with Europe, the more they will trade with countries tightly linked to the dollar, the more the REER's will appreciate.

However, counterbalancing this tendency is the large inflation differential between the Francophone African countries and the booming economies of East Asia, particularly China. Given the tight monetary policy of the Central Banks in the CFA zone contrasting with the more active monetary management in many of the trading partners, this will tend to dampen any gain in the real effective exchange rates of the two zones. Higher inflation in countries like Nigeria, Ghana, China, and Korea will act to contain REER appreciation, provided that the regional central banks in the CFA zones maintain prudent monetary management. However, it is important to note that the extent of misalignment will depend on each individual country and that the regional story may be very different than the story for individual countries, depending on structural characteristics, commodity exports, inflation rates, trading partners, and size.

However, given the growing importance of oil in several Central African countries, notably Chad and Equatorial Guinea, there is a risk of future inflationary pressures on the zone that may appreciate the real effective exchange rate. Central Africa's inflation of less than 1 percent cannot persist indefinitely. While in the 1980s and 1990s, the CFA countries had very low inflation, both in terms of averages and dispersion, relative to other African countries, there is a possibility that higher oil prices may have inflationary consequences for the world economy. Moreover, while the analysis shows that there is no visible Dutch disease effect of aid, the size of the current account deficit in both the CEMAC and the UEMOA zones of close to 6.5 percent of regional GDP suggests that the zone will need large aid and capital inflows to finance the imbalance and consequently, will put some pressure on the REER. The flows will need to supplement the low private savings in the zone, analytical counterparts to the current account deficits.

A long-term secular appreciation of the euro will have longer term adverse consequences on the REER's of the CFA zones. The current institutional setup and the fixed exchange rate regime, involving tradeoffs between macroeconomic and currency stability versus policy flexibility and greater volatility, may be hindered in the long-term by growing uncompetitiveness of nontraditional exports due to appreciation of the currency. While the fixed exchange rate regime confers important benefits, the adjustment to terms of trade shocks becomes more difficult under these circumstances (Zafar, 2004). The macroeconomic stability provided by the fixed exchange rate arrangement and the clear monetary and fiscal policy mix will be contrasted by the limitations on policy flexibility. While the analysis found no precise relationship between terms of trade shocks and REER appreciation, the large asymmetric oil and other commodity shocks that affect the zones will make the task of macroeconomic management even more difficult. In conclusion, the next ten years need to be carefully watched by both policymakers and researchers to better understand the evolution of the euro-dollar relationship and to signal potential overvaluations and loss of export competitiveness in Francophone West and Central Africa.

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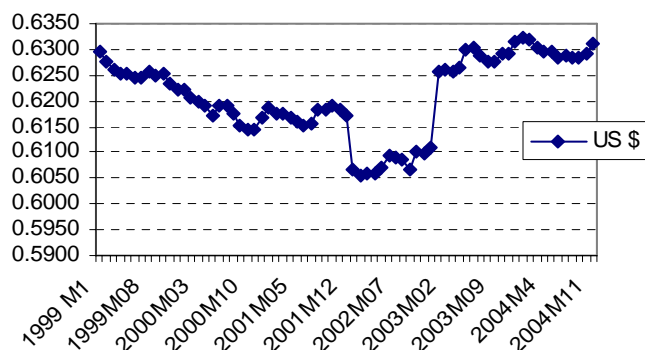
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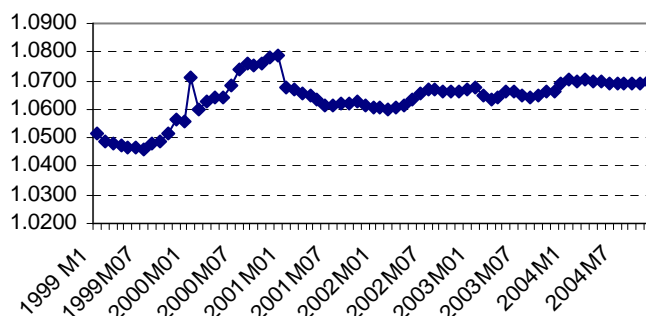


## ANNEX 1 UEMOA BILATERAL EFFECTIVE EXCHANGE RATES

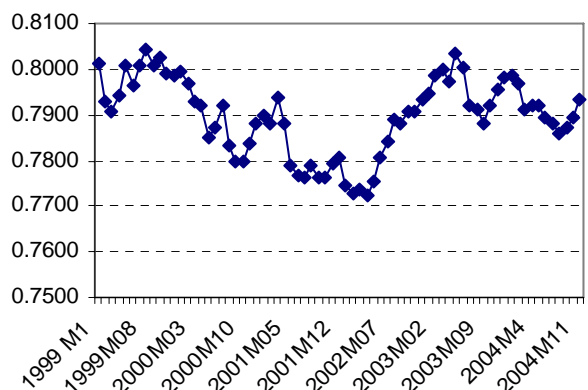
**CHART 1: CFA/ US DOLLAR BILATERAL EFFECTIVE EXCHANGE RATE**



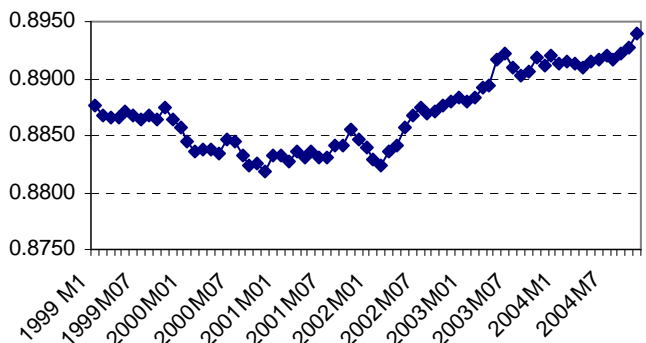
**CHART 2: CFA/ CEDI BILATERAL EFFECTIVE EXCHANGE RATE**



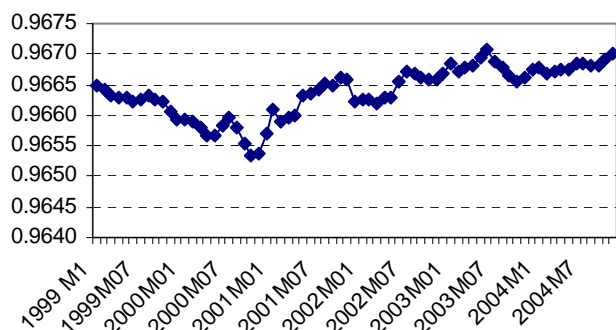
**CHART 3: CFA/NAIRA BILATERAL EFFECTIVE EXCHANGE RATE**



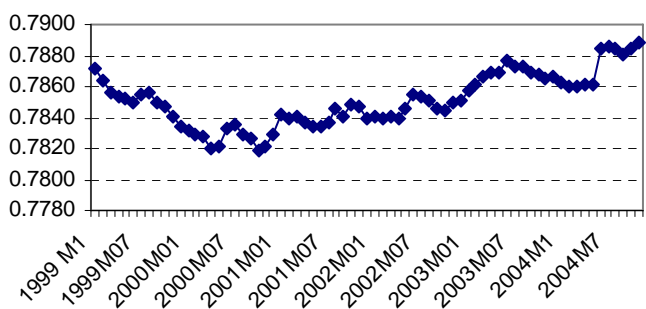
**CHART 4: CFA/YUAN BILATERAL EFFECTIVE EXCHANGE RATE**



**CHART 5: CFA/INDIAN RUPPEE BILATERAL EFFECTIVE EXCHANGE RATE**

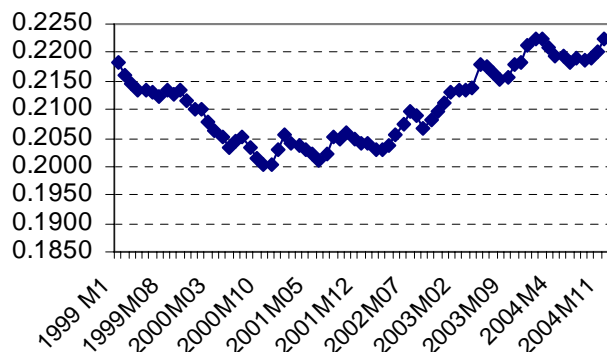


**CHART 6: CFA/ BRITISH POUND BILATERAL EFFECTIVE EXCHANGE RATE**

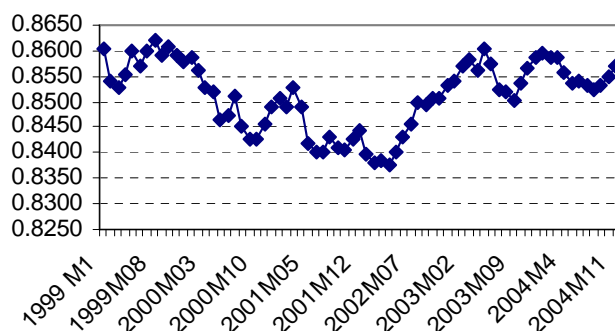


## ANNEX 2 CEMAC BILATERAL EFFECTIVE EXCHANGE RATES

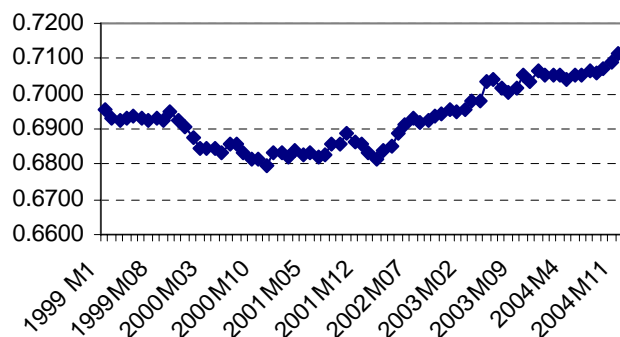
**CHART 1: CFA/ US DOLLAR BILATERAL EFFECTIVE EXCHANGE RATE**



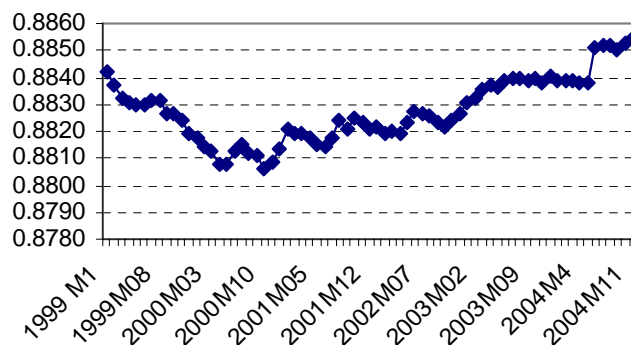
**CHART 2: CFA/NAIRA BILATERAL EFFECTIVE EXCHANGE RATE**



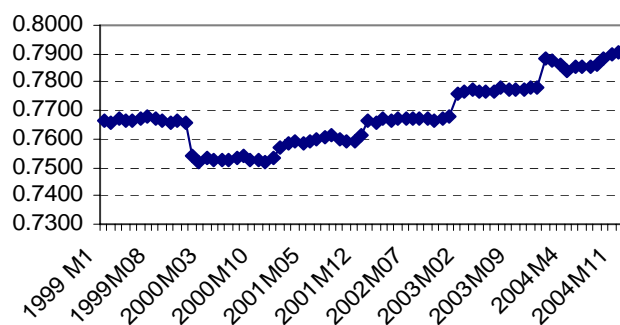
**CHART 3: CFA/YUAN BILATERAL EFFECTIVE EXCHANGE RATE**



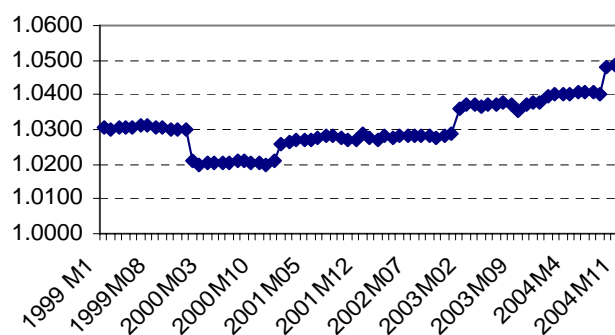
**CHART 4: CFA/ BRITISH POUND BILATERAL EFFECTIVE EXCHANGE RATE**



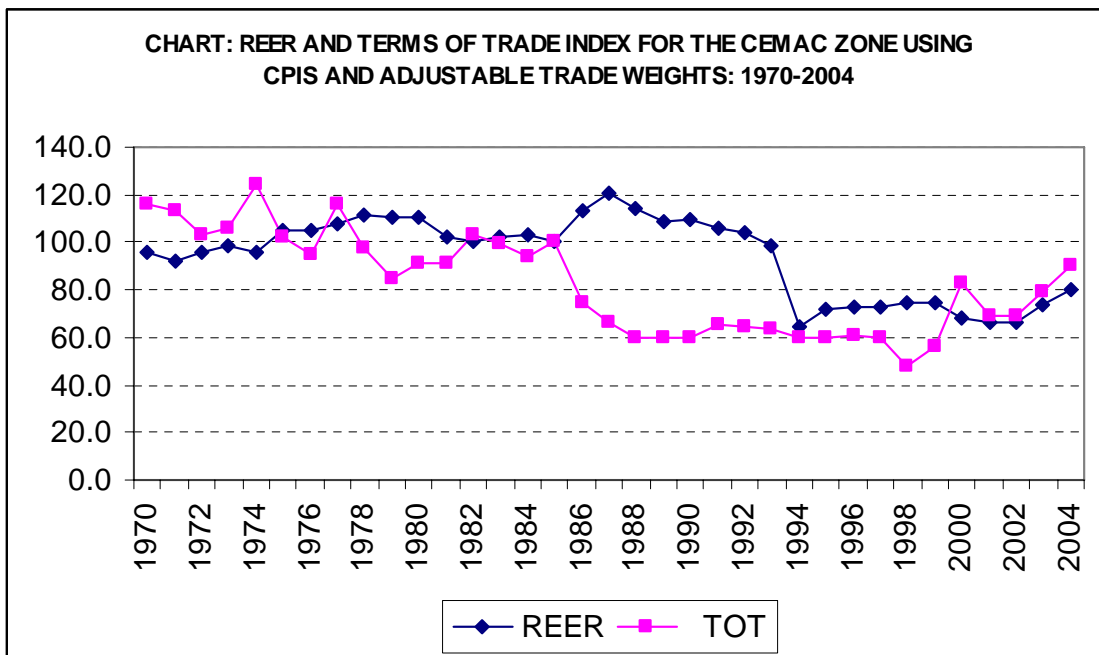
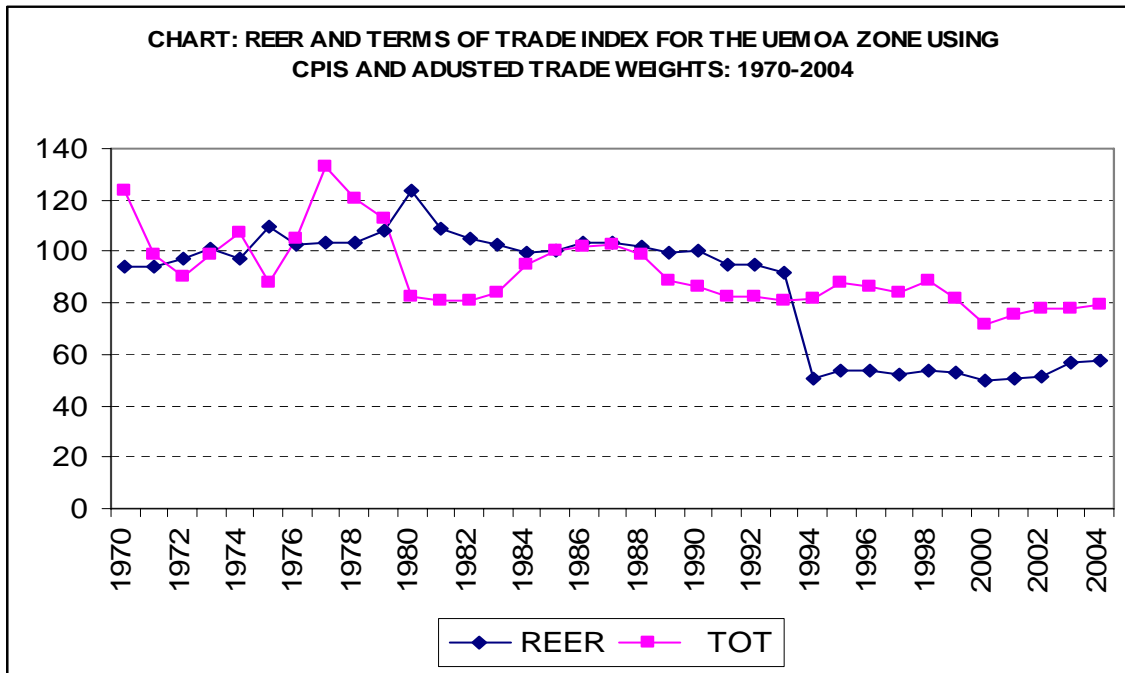
**CHART 5: CFA/ TAIWAN DOLLAR BILATERAL EFFECTIVE EXCHANGE RATE**



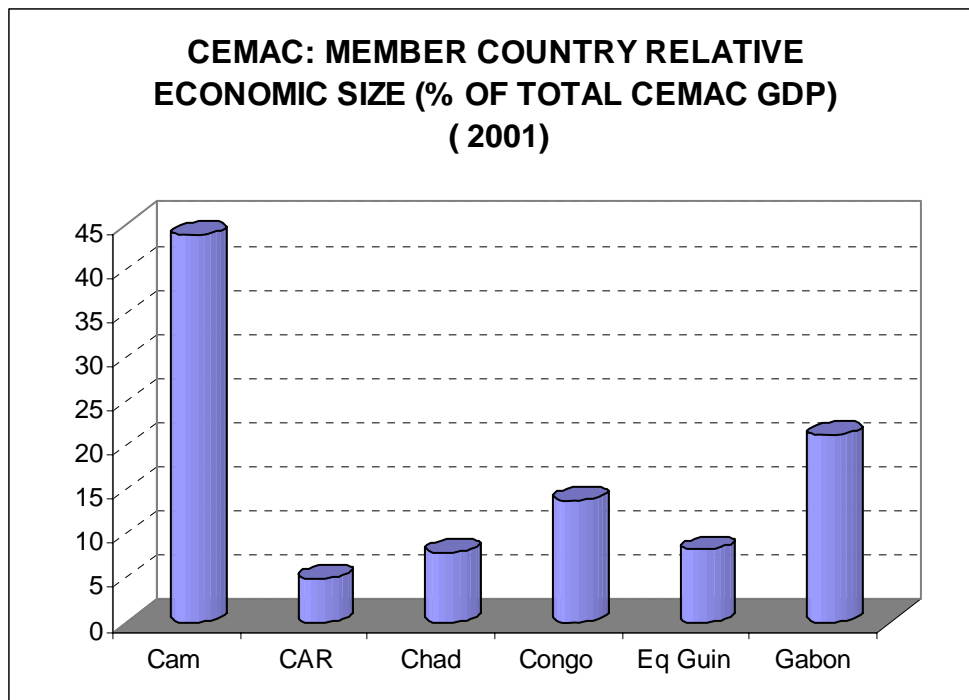
**CHART 6: CFA/ KOREAN WON BILATERAL EFFECTIVE EXCHANGE RATE**



### ANNEX 3: REAL EFFECTIVE EXCHANGE RATES AND TERMS OF TRADE IN THE TWO ZONES

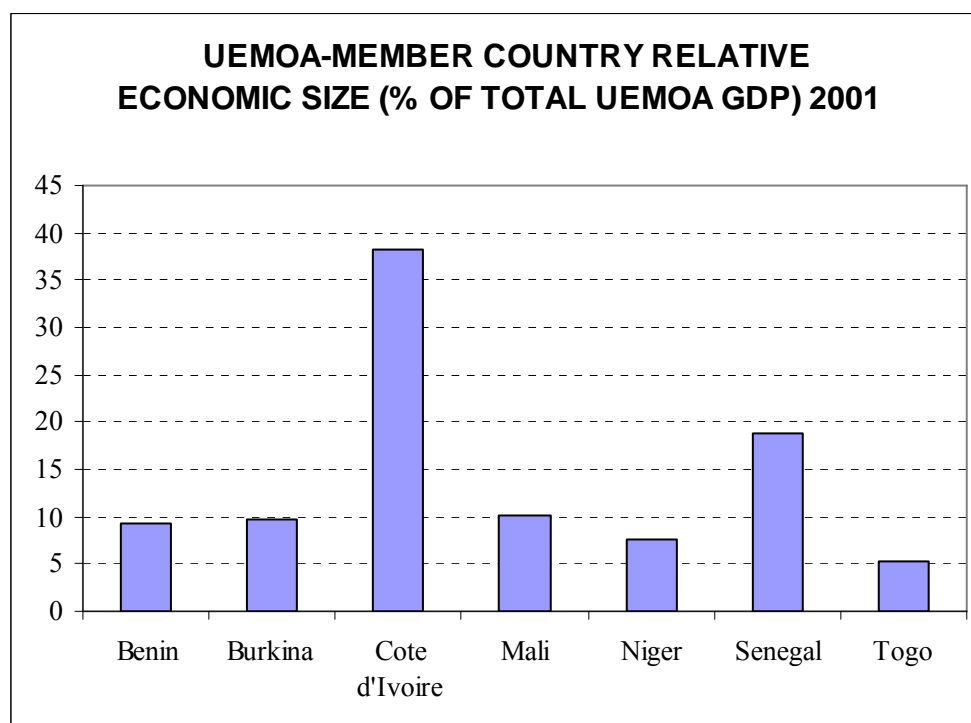


## ANNEX 4: CEMAC COUNTRY ECONOMIC SIZE



*Source: IMF and World Bank databases, 2001*

## ANNEX 5: UEMOA COUNTRY ECONOMIC SIZE



*Source: IMF and World Bank databases, 2001*

## ANNEX 6A: ECONOMETRIC TESTS OF PPP FOR KEY CEMAC AND UEMOA COUNTRIES

In order to ascertain the possible validity of purchasing power parity in the two CFA zones, time series econometric tests were conducted on Cameroon and Senegal using unit root and cointegration tests. The goal was to assess the mean-reversion of two bilateral real exchange rates – the Cameroon CFA/\$US and the Senegal CFA/\$US using monthly observations from January, 1982 to December, 2004.

The following equation was specified:

$$(3) S_t = B_o + B_I(P_t - P_t^*) + u^*$$

where  $S_t$  is the log of the spot exchange rate between the domestic and foreign economy and  $P_t$  is the log of the price level of the domestic economy and  $P_t^*$  is the log of the price level of the foreign economy, and  $t$  is the time. PPP holds if  $B_I$  is not statistically different from 1. Thus, as a first step, the  $B_o$  and  $B_I$  are estimated using traditional OLS techniques. However, since the analysis is of a time series nature, as is well known in the econometrics literature, one has to undertake additional tests because the use of data characterized by unit roots can lead to serious errors in inferences. (Green, 1999) As a second step, Augmented Dickey-Fuller (ADF) tests for unit roots and stationarity are used. Optimal lag lengths have been used using Akaike-Schwartz in order to determine the most robust lag order.

The findings are presented in the accompanying Table. The OLS regression finds high evidence of PPP with high adjusted R-squared of .667 and significant t statistics. However, the ADF tests for unit roots show that we cannot reject the null hypothesis that the log consumer price index in Cameroon contains a unit root since the ADF value of -2.1 is below the ADF critical value of -2.9. The results persist in spite of the lag order, and similar results are obtained for the unit roots of the log spot exchange rate between Cameroon and the US. Thus, there is not evidence of stationarity or mean reversion, and one must reject PPP. The exact same experiment was conducted for Senegal, and the results are roughly the same. (Annex 2)

There are several possible explanations for the failure to find evidence of PPP. Firstly, real exchange rates are extremely volatile in the short-term and converge very slowly to equilibrium. (Frenkel, 1978), Rogoff, 1996). A plethora of analytical work on many developing countries has found it difficult to prove the empirical validity of PPP. Secondly, the volatility of the euro-dollar exchange rate and frequent movements unrelated to economic fundamentals suggests that other factors may affect exchange rate behavior. Third, the CFA zone countries face a lot of volatility and terms of trade shocks, which coupled with the inflexibility of the fixed parity, may affect the mean-reversion of the exchange rate. “Hysteresis” models of international trade emphasize that trade flows may not fully respond in the short-run to a change in the real exchange rate because of presence of adjustment costs. (Clark et al, 2000) Finally, the Balassa-Samuelson hypothesis in which productivity differentials between the traded and non-traded sectors in the economy of a country relative to the trading partners result in an appreciation of the real effective exchange rate, may be a relevant (Balassa, 1964).

## ANNEX 6B: RESULTS OF OLS REGRESSIONS AND DICKEY-FULLER UNIT ROOT TESTS FOR CAMEROON CFA/ \$US PPP

### TEST 1: OLS

Source	SS	df	MS	Number of obs	=	148
				F( 1, 146)	=	293.57
Model	9.80781144	1	9.80781144			
Residual	4.87761509	146	.033408323	R-squared	=	0.6679
				Adj R-squared	=	0.6656
Total	14.6854265	147	.099900861	Root MSE	=	.18278

lnx	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
lnp	2.619999	.1529123	17.134	0.000	2.317792 2.922207
_cons	5.806328	.0309036	187.885	0.000	5.745252 5.867404

lnx = CFA franc/ \$US monthly exchange rate

ln p = lncpi (Cameroon) – lncpi (US)

### TEST 2: DICKEY-FULLER

Dickey-Fuller test for unit root      Number of obs = 147

----- Interpolated Dickey-Fuller -----				
Test	1% Critical	5% Critical	10% Critical	
Statistic	Value	Value	Value	
Z(t)	-2.120	-3.494	-2.887	-2.577

\* MacKinnon approximate p-value for Z(t) = 0.2367

# **ANNEX 7: ORIGINAL TRADE WEIGHTS IN WEST AND CENTRAL AFRICA USED FOR REER CALCULATIONS**

## **UEMOA TRADE WEIGHTS**

	2000	2001	AVG
Belgium- Luxembourg	0.01	0.01	0.01
France	0.173	0.171	0.172
Germany	0.029	0.033	0.031
Italy	0.038	0.038	0.038
Netherlands	0.056	0.055	0.0555
Spain	0.015	0.016	0.0155
UK	0.021	0.020	0.0205
Portugal	0.005	0.005	0.005
Cameroon	0.005	0.005	0.005
Ghana	0.018	0.023	0.0205
China	0.017	0.017	0.017
Indonesia	0.007	0.007	0.007
Taiwan	0.005	0.005	0.005
Brazil	0.010	0.010	0.01
Canada	0.006	0.007	0.0065
US	0.043	0.044	0.0435
Nigeria	0.082	0.064	0.073
Japan	0.017	0.014	0.0155
Moroco	0.005	0.005	0.005
India	0.026	0.026	0.026
Thailand	0.017	0.021	0.019
Algeria	0.003	0.002	0.0023
IntraUEMOA	0.11	0.11	0.11
	0.734	0.7236	

## **CEMAC TRADE WEIGHTS**

Belgium- Luxembourg	0.019
France	0.188
Germany	0.022
Italy	0.055
Netherlands	0.22
Spain	0.067
UK	0.014
Portugal	0.009
China	0.064
US	0.211
Nigeria	0.02
Japan	0.013
Korea	0.041
IntraCEMAC	0.05
SUM	0.993



